EFFECT OF DIETARY CONJUGATED LINOLEIC ACID ON THE GROWTH, CARCASS CHARACTERISTICS AND MEAT FATTY ACID COMPOSITION FOR TLRI BLACK PIG NO.1

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ABSTRACT

The purpose of this study was to investigate the effect of supplementing conjugated fatty acid (CLA) on the growth, carcass quality and lean meat composition of TLRI Black Pig No.1 (TBP). A total of 50 TBP barrows, with body weight (BW) 60 kg, were divided into 5 groups. The first group was control. The 2nd to 5th group were 2 dietary levels of CLA (1.5 g/kg and 3.0 g/kg) used when the body weights of the pigs was either 60 kg (BW 60) or 90 kg (BW 90). Growth performance, carcass characteristics and meat fatty acid composition were measured. The result showed that pigs fed 3.0 g/kg CLA from BW 60 had higher ($P < 0.01$) average daily feed intake, ADG ($P < 0.05$) and lower G/F than control. For carcass characteristics, pigs fed 3.0 g/kg CLA started at BW 60 had smaller ($P < 0.05$) bellyfat thickness, higher ($P < 0.05$) carcass percentage lean and loin eye area (LEA). Besides, higher ($P < 0.05$) crude fat, linoleic acid, PUFA and iodine value was also observed in Longissimus dorsi muscle from pigs fed 3.0 g/kg CLA from BW 60. Pigs fed 3.0 g/kg CLA from BW 90 decreased ($P < 0.05$) carcass percentage fat. The addition of CLA, 1.5 g/kg or 3.0 g/kg, in finisher diet either from BW 60 or BW 90 increased ($P < 0.05$) carcass percentage lean. The supplementation of CLA during the fast fat accumulation period of barrows significantly ($P < 0.05$) reduced the fat deposition. In conclusion, the dietary supplementation of CLA increased the LEA and fat percentage of meat and the supplementation of 3.0 g/kg CLA started from BW 60 significantly ($P < 0.05$) reduced the bellyfat thickness and carcass percentage fat when the supplementation was started from BW 90.

KEY WORD: Barrow, Carcass characteristics, Conjugated fatty acid, Growth performance, TLRI Black Pig No.1.

INTRODUCTION

Conjugated fatty acid is a group of geometric and positional isomers of linoleic acid. Dietary CLA has been shown to have nutrients partitioning effect. Thiel-Cooper *et al.* (2001) indicated that dietary supplementation of CLA improved the G/F and reduce the body fat content of growing-finishing pigs. Dugan *et al.* (1997) showed that the dietary supplementation of 2 % CLA increased the fat percentage in lean meat and increased intramuscular fat in *Longissimus dorsi* muscle. Lauridsen *et al.* (2005) indicated that dietary supplementation of CLA increased the saturated fatty acid content in porcine adipose tissue and decreased the monounsaturated fatty acid. The TBP was a breed developed by Livestock Research Institute, COA. Su *et al.* (2004) showed that TBP barrows had higher ($P < 0.05$) average daily feed intake, backfat thickness and carcass percentage fat, lower ($P < 0.05$) G/F and LEA when

compared to gilt during BW 130. In order to improve the carcass quality of TBP barrows, the purpose of this study was to investigate the effect of dietary supplementation of CLA at different body weights on the growth, carcass characteristics and lean meat composition of TBP barrows.

MATERIALS AND METHODS

Animals and diet

A total of 50 TBP barrows, with average body weight 60 kg, were divided into 5 groups**.** The first group was control (CLA-). The 2^{nd} to 5^{th} groups were: 2 dietary levels of CLA (1.5 g/kg and 3.0 g/kg) used when the body weights of the pigs was either 60 kg (BW 60) or 90 kg (BW 90). Pigs were individually fed and feed and water were provided *ad libitum*. Feeding experiment was finished when BW of animals reached 120 ± 3 kg. Animals were weighed every two weeks. Feed consumption was recorded for measuring growth performance.

Carcass characteristics and meat color measurement

All animals were slaughtered at approximately BW 120. Carcass characteristics including LEA, backfat thickness, bellyfat thickness and carcass percentage lean and fat were determined. Minolta L, a, b value were measured with Color reader (Color reader, CR-10, Minolta Co., Ltd., Japan) on the *Longissimus dorsi* muscle collected between 10^{th}-11^{th} rib of left half carcass.

Chemical and fatty acid composition of meat

The chemical composition were determined by AOAC (1995) method. The fatty acid composition of meat was analyzed by the method of Sukhija and Palmquist (1988).

Statistical analysis

All data were analyzed by ANOVA as a completely randomized design with 5 treatments. All procedures of statistical analysis were computing using the General Linear Model by Statistical Analysis System (SAS, 2002).

RESULTS AND DISCUSSION

Pigs fed 3.0 g/kg CLA from BW 60 had larger ($P < 0.01$) average daily feed intake, ADG and lower G/F than control (Table 1), which is consistent to the result of Weigand *et al.* (2002). For carcass characteristics, pigs fed 3.0 g/kg CLA started at BW 60 had smaller ($P < 0.05$) bellyfat thickness, higher ($P < 0.05$) carcass percentage lean and LEA. This improvement in carcass quality was also observed in the works of Ostrowska *et al.* (1999) and Weigand *et al.* (2002).

Higher ($P < 0.05$) crude fat, linoleic acid, PUFA content and iodine value was found in *Longissimus dorsi* muscle from pigs fed 3.0 g/kg CLA started at BW 60. Pigs fed 3.0 g/kg CLA from BW 90 also increased ($P < 0.05$) LEA and decreased ($P < 0.05$) carcass percentage fat. The addition of CLA, 1.5 g/kg or 3.0 g/kg, in finisher diet either from BW 60 or BW 90 increased ($P < 0.05$) carcass percentage lean. A longer period of supplementation of CLA in TBP barrows increased the fat content in meat, which was also found by Dugan *et al.* (1999). The supplementation of CLA during the fast fat accumulation period of TBP barrows, i.e. BW 90 significantly ($P < 0.05$) reduced carcass percentage fat. In conclusion, the dietary

supplementation of 3.0 g/kg CLA starting from BW 60 can reduce the bellyfat content and increase the carcass percentage lean and the fat content in the *Longissimus dorsi* muscle.

Table 1. Effects of dietary CLA on growth and carcass characteristics of the TBP barrows

	Body weight at CLA used, kg					
	Control*	60	90	60	90	
CLA amount, g /kg	0	1.5	1.5	3.0	3.0	SEM
Growth performance						
ADG, kg	0.56^{b}	0.59^{ab}	0.58^{ab}	0.63^{a}	0.59^{ab}	0.02
ADFI, kg	2.44^{c}	2.75^{ab}	2.55^{bc}	2.97^{a}	2.43^{c}	0.10
Gain/Feed	0.229^{ab}	0.217^{ab}	0.230^{ab}	0.213^{b}	0.247^{a}	0.009
Carcass characteristics						
Backfat thickness, mm	23.8	21.3	24.7	22.0	22.8	1.3
Bellyfat thickness, mm	23.9^{a}	24.5^{a}	24.2^{a}	17.6^{b}	23.0^{a}	1.3
Loin eye area, cm^2	38.7^{b}	39.7^{b}	41.1^{ab}	43.4^{a}	43.4^{a}	1.1
Percentage lean, %	48.1^{c}	50.0^{ab}	50.1^{ab}	50.6^{a}	49.2^{bc}	0.4
Percentage fat, %	13.6^{a}	13.0^{ab}	12.8^{ab}	13.0^{ab}	10.8^{b}	0.7

*Pigs in control group was started the experiment at BW 60.
$^{a\ b}$ Means with different superscripts in the same row differ significantly ($P < 0.05$).

Higher ($P < 0.05$) crude fat, linoleic acid, PUFA content and iodine value was found in *Longissimus dorsi* muscle from pigs fed 3.0 g/kg CLA started at BW 60. Pigs fed 3.0 g/kg CLA from BW 90 also increased ($P < 0.05$) LEA and decreased ($P < 0.05$) carcass percentage fat. The addition of CLA, 1.5 g/kg or 3.0 g/kg, in finisher diet either from BW 60 or BW 90 increased ($P < 0.05$) carcass percentage lean. A longer period of supplementation of CLA in TBP barrows increased the fat content in meat, which was also found by Dugan *et al.* (1999). The supplementation of CLA during the fast fat accumulation period of TBP barrows, i.e. BW 90 significantly ($P < 0.05$) reduced carcass percentage fat. In conclusion, the dietary supplementation of 3.0 g/kg CLA starting from BW 60 can reduce the bellyfat content and increase the carcass percentage lean and the fat content in the *Longissimus dorsi* muscle.

REFERENCE

AOAC. 1990. Office Methods of Analysis. 15th ed. Association of Office Analytical Chemists, Arlington, VA.

AOCS. 1998. Official Methods and Recommended Practices of the AOCS, 5th ed. Am. Oil. Chem. Soc., Champaign, IL.

Dugan, M. E. R., J. L. Aslhus, L. E. Jeremiah, J. K. G. Kramer, and A. L. Schaefer. 1999. The effects of conjugated linoleic acid on fat to lean repartitioning and feed conversion in pigs. Can. J. Anim. Sci. 79: 45-51.

Dugan, M. E. R., J. L. Aslhus, A. L. Schaefer, and J. K. G. Kramer. 1997. The effects of feeding conjugated linoleic acid on subsequent pork quality. Can. J. Anim. Sci. 77: 723-725.

Lauridsen, C., H. Mu, and P. Henckel. 2005. Influence of dietary conjugated linoleic acid (CLA) and age at slaughtering on performance, slaughter- and meat quality, lipoproteins, and tissue deposition of CLA in barrows. Meat Sci. 69: 393-399.

Ostrowska, E., M. Morley, F. C. Reg, E. B. Dale, and R. D. Frank. 1999. Dietary conjugated linoleic acids increase lean tissue and decrease fat deposition in growing pigs. J. Nutr. 129: 2037-2042.

Thiel-Cooper, R. L., F. C. Jr. Parrish, J. C. Sparks, B. R. Wiegand, and R. C. Ewan. 2001. Conjugated linoleic acid changes swine performance and carcass composition. J. Anim. Sci. 79:1821-1828.

SAS. 2002. SAS procedure guide for personal computers. Version 6th Ed. SAS Institude Inc. Cary, NC. U.S.A.

Su, T. M., C. F. Liu, C. S. Tsai, and C. W. Liao. 2004. Investigation on the growth performance and carcass trait at different slaughter weights for TLRI Black Pig No.1. J. Chin. Soc. Anim. Sci. 33: 165-174.

Sukhija, P. S. and D. L. Palmquist. 1988. Rapid method for determination of total fatty acid content and composition of feedstuffs and feces. J. Agric. Food Chem. 119: 521-528.

Wiegand, B. R., J. C. Sparks, F. C. Parrish and D. R. Zimmerman.2002. Duration of feeding conjugated linoleic acid influences growth performance, carcass traits, and meat quality of finishing barrows. J. Anim. Sci. 80:637-643.

Table 2. Effects of dietary CLA on the chemical compositions and fatty acid compositions of *Longissimus dorsi* muscle of the TBP barrows

	Body weight at CLA used, kg					
	Control	60	90	60	90	
CLA amount, g/kg	0	1.5	1.5	3.0	3.0	SEM
Chemical compositions						
Moisture, %	74.2[a]	73.2[ab]	74.0[a]	72.6[b]	74.1[a]	0.4
Crude fat, %	2.67[b]	3.49[ab]	2.85[b]	4.60[a]	3.24[ab]	0.49
L value	54.8[ab]	57.4[a]	52.5[b]	51.8[b]	57.7[a]	1.5
Fatty acid composition, %						
$C_{14:0}$	1.39[ab]	1.38[ab]	1.43[ab]	1.34[b]	1.49[a]	0.05
$C_{16:0}$	26.4[ab]	26.9[a]	25.8[ab]	25.0[b]	26.6[a]	0.48
$C_{16:1}$	3.58	3.85	3.17	3.91	3.72	0.33
$C_{18:0}$	14.9	15.0	15.5	14.8	15.1	0.47
$C_{18:1}$	41.6	41.8	41.3	39.8	39.9	0.7
$C_{18:2}$	11.0[b]	10.0[b]	11.6[ab]	13.7[a]	12.2[ab]	0.76
$C_{18:3}$	0.69[ab]	0.62[b]	0.75[a]	0.69[ab]	0.70[ab]	0.04
$C_{20:0}$	0.19	0.18	0.22	0.42	0.22	0.08
Total saturated fatty acid	43.1	43.8	43.2	41.9	43.9	0.8
Total monounsaturated fatty acid	45.2	45.6	44.4	43.8	43.6	0.76
Total polyunsaturated fatty acid	11.7[b]	10.6[b]	12.4[ab]	14.4[a]	12.9[ab]	0.78
Iodine value[d] (IV)	60.1[ab]	58.4[b]	60.6[ab]	63.5[a]	60.7[ab]	1.2

[a, b] As Table 1.
[d] Estimated value, IV= C16:1 (0.95) + C18:1 (0.86) + C18:2 (1.732) + C18:3 (2.616) (AOCS, 1998)